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WATER QUALITY EVALUATION OF THE GRAND MESA PROJECT COLORADO

Environmental Protection Agency
Denver, Colorado

December 1971

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An evaluation of the Bureau of Reclamation's proposed Grand Mesa Project indicates that with adequate treatment municipal, industrial and other domestic waste loadings should not significantly affect water quality for present and projected water uses in the Project area. Therefore, no storage in Electric Mountain and Cactus Park Reservoirs is needed to provide flow regulation for maintaining satisfactory water quality in the Gunnison River. The use of Project water for irrigation, municipal, and industrial purposes will result in an estimated average annual increase of 3.0 mg/l in the total dissolved solids concentration of the Colorado River at Lake Mead. The economic impact of this salinity increase upon water users below Lake Mead is estimated to be $205,000 annually, based on 1970 economic conditions. Control measures are recommended for incorporation into the construction and operation of the Project to mitigate the adverse effects of increased salinity.

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I. INTRODUCTION

PURPOSE AND SCOPE

This water quality evaluation has been prepared for the U. S. Department of the Interior, Bureau of Reclamation, Region 4, Salt Lake City, Utah, for inclusion in their feasibility report for the Grand Mesa Project, Colorado. The Primary purposes of this evaluation are:

1. To determine the need for and value of separable reservoir storage for streamflow regulation to control water quality;

2. To assess the overall impact of the proposed development on water quality, both in and outside the Project area; and

3. To recommend, where applicable, water quality control measures for the Project.

The evaluation was made of the effect of the Project in the Gunnison River drainage area in West Central Colorado and downstream areas of the Colorado River Basin.

This report has been prepared under the authority of and in accordance with provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.) and Executive Order 11507, dated February 5, 1970, and at the request of the Bureau of Reclamation. Section 3 (b) of the Act requires that consideration shall be given to inclusion of storage for regulation of streamflow for the purpose of water quality control, except that any such storage shall not be provided as a substitute for adequate treatment or other methods of controlling waste at the source. Section 7 of Executive Order 11507 requires the preparation of a report describing the potential impact of Federal water resource projects on water quality.

Basic data for this evaluation were supplied by the Grand Junction Projects Office, Region 4, Bureau of Reclamation. The assistance and cooperation given by the U. S. Fish and Wildlife Service are also gratefully acknowledged.

PROJECT DESCIPTION

The proposed Grand Mesa Project is located on the southern base of Grand Mesa near the communities of Cedaredge and Hotchkiss in the Gunnison River Basin of West Central Colorado (see page preceding back cover). The project will provide irrigation water for 28,270 acres, develop 5,000 acre-feet of municipal and industrial water, and provide reservoir-related recreation and fish and wildlife opportunities. Electric

Mountain and Cactus Park Reservoirs will be the Project's main features. Electric Mountain Reservoir will be formed by a dam on West Muddy Creek about 1-1/2 miles above the West Muddy Ranger Station. Surplus flows of West Muddy Creek supplemented by surplus flows of Cow Creek will be stored in the reservoir. The Grand Mesa Canal will convey reservoir releases and direct flows of intervening streams across the southern slope of Grand Mesa to Cactus Park Reservoir serving Project lands along its route. Cactus Park Reservoir will be constructed on a Currant Creek tributary approximately 4 miles east of Cedaredge. The Surface Creek Feeder Canal will convey surplus flows of Surface and Young Creeks to the reservoir to supplement the Grand Mesa Canal inflows. Reservoir releases will be made to the Cedaredge Canal for conveyance to Project lands and to municipal and domestic water delivery points. Project lands above the canal will receive water by exchange made possible through storage regulation in Cactus Park Reservoir and construction of the Fruitgrowers and Ward Creek Feeder Canals. The feeder canals will convey Project return flows and surplus flows of Ward and Surface Creeks to the existing Fruitgrowers Reservoir to replace the exchange water used upstream. Approximately 5,000 acre-feet of stabilized storage will be provided in existing reservoirs on Grand Mesa for fishery and recreation purposes.

II. PROJECT IMPACT ON WATER QUALITY

To evaluate the impact of a water resources development project on water quality, it is necessary to examine the various factors that influence water quality. The economy and water supply in an area affect the amount and type of water use. Data must be developed on the present and projected economy of the study area to estimate future municipal and industrial use of Project water and the resulting waste loads. The same economic and demographic data may also be useful in evaluating any water quality control measures incorporated into the Project plan. The water use influences waste sources and the quality of water downstream from the point of use. Any changes in the quality of water may have an economic impact on downstream water users.

LOCAL ECONOMY

Agriculture is the principal economic activity on Project lands. Fruit growing accounts for most of the agricultural income. Dairying and cattle raising occupy lesser roles. A farm management survey completed by the Bureau of Reclamation in 1969 analyzed 32 Project area farms operated by 36 families. The farms surveyed make up 7,800 acres, irrigated and non-irrigated, and are considered representative of Project lands. The farms consisted of 11 full-time fruit farms, 5 livestock beef farms, 2 "Grade A" dairy farms, 1 sheep farm, 3 general farms, and 10 part-time farms. The lands supported a total of 1,241 beef cattle, 204 hogs, 244 sheep, and 217 dairy cattle dispersed over more than 4,000 acres. Because the climate in the Grand Mesa area is favorable to growing fruit, it is expected the trend will be from livestock farming and toward fruit growing when a full water supply is provided by the Project.

Limited employment is provided on Project lands by several small coal mines, sawmills, and fruit packing companies. The area is located near Grand Mesa, the world's largest flat-top mountain and known for its outstanding recreational facilities. Tourism and vacationers are a major revenue source to the merchants of Cedaredge and Orchard City during the summer months. The mild winters and pleasant summers attract numerous retired people to the area, and it is for this reason that population in the Project area is increasing faster than in the remainder of Delta County.

Cedaredge and Orchard City are the only incorporated communities within the Project area. The town of Delta, located about ten miles southwest of the Project area is the principal trading center for the area and is the County Seat for Delta County.

Present population in the Project area is estimated to be about 3,500. The project area is growing faster than the surrounding area and a moderate annual growth rate of 1.1% (1) is forecast through 2010. The past, present, and future area population is tabulated below.

Project Area Population

Community or Area	1960	1970	1985	2010	Annual Growth Rate
Cedaredge	549	581	750	940	1.1%
Orchard City	1,021	1,163	1,350	1,670	1.1%
Delta	3,832	3,694	4,730	5,500	0.7%
Delta County	15,602	15,286	15,100		.0%
Project Area	-	3,500	4,400	5,450	1.1%

WATER SUPPLY

Water supply in the Project area is related to several streams. West Muddy and Cow Creeks, with an average annual flow of 12,000 and 5,700 acre-feet respectively(1), will supply surplus flows to Electric Mountain Reservoir. Flows will be released from the reservoir to the Grand Mesa Canal, which will convey these flows along with direct flows of intervening streams to irrigable land and to Cactus Park Reservoir. The intervening streams; Hubbard, Terror, and Leroux Creeks and Roatcap Gulch, will supply an average annual flow of 32,300 acre-feet. Youngs Creek near Grand Mesa and Surface Creek at Cedaredge have an average annual flow of 4,970 and 19,620 acre-feet respectively.(2) Surplus flows of Youngs and Surface Creeks will also be conveyed to Cactus Park Reservoir. These two reservoirs will provide an average annual supply of 57,100 acre-feet to the Project.

The North Fork of the Gunnison River, which joins the Gunnison River near Lazear, Colorado, and the Gunnison River lie just south of the Project area. The average annual flow (1962-1967 period of record) of the Gunnison River near Lazear is 870,900 acre-feet which is representative of the flow past the Project area(2). The average annual flow (1951-1966 period of record) of the Gunnison River at its confluence with the Colorado River at Grand Junction, Colorado, is 1,556,305 acre-feet(2). The present modified1/ average annual flow

1/ The present modified condition includes adjustments of the historic condition based on the assumption that new developments begun during the 1941-1968 period were in operation for the full period.

of the Colorado River at Hoover Dam is 10,119,000 acre-feet(3). The Project will deplete the flow of the Gunnison River by 26,700 acre-feet annually resulting in an average annual flow of 852,200 acre-feet in the Gunnison River just below the Project area, 1,529,605 acre-feet in the Gunnison River at Grand Junction, and 10,092,300 acre-feet in the Colorado River at Hoover Dam.

The project will deplete the North Fork Gunnison River by 30,000 acre-feet annually. Except for the lessening of stream fishery flows during the winter months, this will not affect the present or projected uses of the North Fork, since the water diverted into the Grand Mesa Canal from the intervening streams would be surplus to downstream needs. Other water resource developments along the North Fork will not affect the uses of the river except as mentioned previously. Although the Paonia Project depletes the North Fork by 9,800 acre-feet annually, Paonia Reservoir, by regulating the runoff from Muddy Creek, improves the distribution of flow in the North Fork. The calculated minimum flow of the North Fork just before its confluence with the Gunnison River is 43 cubic feet per second (1957-1969 period of record).

WATER USE

Irrigation is the primary water use in the Project area. Approximately 29,840 acres are presently irrigated. The principal crops grown are alfalfa, pastures, small grains, corn, apples, peaches, cherries, pears, and apricots.

Water for domestic use in Cedaredge is supplied from springs on the south slope of the Grand Mesa. The Town of Orchard City and the homes below Cedaredge receive a separate supply of water piped in from Grand Mesa. This water supply system is municipally owned by the Town of Orchard City. The Orchard City system also supplies water to farms in the Project area. The Upper Surface Creek Water Users Association, which has approximately 160 taps serving about 310 persons, serves the Cedar Mesa area. Water for the Cedaredge state fish hatchery is supplied primarily by the Town of Cedaredge.

The predominant recreational water use in the project area is for trout fishing in lakes, streams, and reservoirs on Grand Mesa.

Above the Project area, the main uses of Gunnison River water are for irrigation and hydroelectric power generation. Between the Project area and Lake Mead, Gunnison and Colorado River water is used primarily for irrigation of fruit crops in the Grand Valley Irrigation District, and hydroelectric power generation at Glen Canyon Dam. Below Lake Mead, Colorado River water is diverted for irrigation, municipal, industrial, livestock, and hydroelectric power generation uses with irrigation use being predominant. Recreation and fishing have become important on the waters of the North Fork drainage above the project area and on the Gunnison and Colorado Rivers downstream.

The Project will supply annually 52,100 acre-feet of irrigation water for 28,270 acres. Of this total, 7,430 acres will be new lands and will receive a full supply while the remaining 20,840 acres of presently irrigated lands will receive a supplemental supply. A total of 1,300 acre-feet will be provided for municipal and industrial uses and 3,600 acre-feet for use at the Cedaredge fish hatchery. The Upper Surface Creek Valley Water Users Association has requested 1300 acre-feet per year of Project water from Cactus Park Reservoir for municipal and industrial uses. Since the reservoir is expected to experience heavy recreational use, the Association will need to provide complete treatment for the water to insure a safe supply. This would be in accord with an American Water Works Association policy which states, "water withdrawn from multipurpose reservoirs for domestic water supply purposes shall be given the same complete treatment as those waters derived from polluted sources." If the reservoir has heavy motor boat usage, the treatment of the water would be further complicated due to fuel and oil leakage.

POLLUTION SOURCES

Increased salinity (total dissolved solids) of the lower Colorado River will be the major water quality problem resulting from development of the Project. Irrigation is the activity of man that contributes most to the increase of salinity concentrations. Two factors associated with irrigation cause this increase. First, water is lost by evaporation and evapotranspiration with no accompanying loss of salt, thereby causing salinity concentrations to increase. Secondly, the pickup of salts from irrigated lands in excess of quantities required for maintaining a salt balance1/ causes an increase in salinity.

From general analysis of the project area, it is estimated that new lands will contribute two tons of salt per acre or a total of 14,860 tons annually. It is believed that supplemental service lands have been leached free of all but minor amounts of soluble salts and will add only a small undeterminable amount of salt load to the river system. The rate of salt pickup by irrigation is still largely an unknown factor and the estimates may change with additional detailed investigations. W. W. Ioms[4] estimated that municipal water use will add about 100 tons of salt annually per 1,000 population. Thus, with a projected population increase of 1,950 in the Project area by 2010, 195 tons of salt will be added annually to the river system.

The domestic wastes in the Project area are presently treated primarily by individual septic tank facilities. The septic tanks work effectively in the Project area and will not have a significant effect on the water quality of the river systems.

1/ Salt balance is defined as the removal of a quantity of salt equal to that applied in the irrigation water.

Domestic wastes from the U. S. Forest Service recreational areas on Grand Mesa are generally contained in sealed vaults; however, a few septic tanks are in use.

It is expected that the future wastes associated with recreational activities on the Grand Mesa and the proposed reservoirs will be adequately treated in systems that will not discharge treated effluent to the lakes or reservoirs.

Range cattle and dairy operations are sources of untreated organic wastes in the Project areas. Although the quantity of waste reaching the Gunnison River from these operations is not known, these waste sources are not presently causing any known water quality problems in the area.

Nutrients, pesticides, herbicides, heat and radioactive substances discharged to basin streams are emerging water quality problems in certain areas of the Colorado River Basin. However, these water quality problems are not expected to be significant in the Project area during the period of study. With adequate treatment of wastes at the source, no water quality problems are anticipated from the other industries in the Project area.

PHYSICAL AND ECONOMIC IMPACTS

The major characteristics which determine the suitability of local water supplies for irrigation are the concentrations of total dissolved solids, boron and the relative concentration of sodium to other cations (sodium adsorption ratio). Waters in the Project area have been demonstrated by past use to be suitable for irrigation of crops presently grown.

Upon completion of the Project the average annual total dissolved solids (TDS) concentrations of the waters at Electric Mountain and Cactus Park Reservoir will be about 115 mg/l and 65 mg/l respectively.

The sodium adsorption ratio (SAR) of water to be used in the Project area is within the tolerance limit of crops grown. Boron concentrations are low and, therefore, have no effect on irrigated crops.

It is assumed that in the future municipal and domestic wastes in the Project area will be treated by a wastewater treatment plant located near the Gunnison River. The estimated minimum flow of the Gunnison River past the Project area which would be required to assimilate the projected municipal and domestic waste load after treatment is about 7.0 cfs. It is estimated that this flow will allow a dissolved oxygen concentration of 5.0 mg/l to be maintained to meet the state water quality standards criteria for this reach of the Gunnison River

as shown in the tabulation below. The assumptions used in calculating the minimum flow requirements are as follows:

1. The Project area's population in 2010 will be 5,450.

2. Each population equivalent contributes 0.17 pounds of five-day 20°C biochemical oxygen demand (BOD_5).

3. There will always be waste treatment facilities in the Project area capable of removing 85 percent of the BOD_5 contributed by the entire population.

The lowest flow recorded at the U. S. Geological Survey gaging stations nearest the Project area has been 115 cfs, which is more than adequate to meet the minimum flow required for waste assimilation.

Water Quality Standards for Gunnison River

Designated Water Use for Gunnison River from Confluence with North Fork to Confluence with Colorado River	Standards of Quality 1/		
	Dissolved Oxygen (mg/l)	Temp. °F	pH
Warm Water Fishery	>5	<90	6.5-8.5
Industrial Water Supply			

Salinity is the water quality parameter of major importance outside the Project area. The average annual present modified total dissolved solids concentrations of the Gunnison River at Grand Junction and of the Colorado River at Lake Mead are about 646 and 760 mg/l, respectively. (3) The total dissolved solids concentrations in the Gunnison River at Grand Junction and in the Colorado River at Lees Ferry and all points downstream presently exceed U. S. Public Health Service recommended limits for drinking water. Project development will cause an increase in these salinity concentrations. The average annual salinity increase is expected to be 18 mg/l in the Gunnison River at Grand Junction and 3 mg/l in the Colorado River at Lake Mead.

The mineral quality of water discharged from Hoover Dam does not fluctuate greatly from month to month because of the large amount of water stored in Lake Powell and Lake Mead. However, the mineral quality of the Gunnison River at Grand Junction does fluctuate widely during the year. One of the effects of the Project on water quality,

1/ Adapted from State of Colorado Water Quality Standards documents; refer to state standards for specific language and additional criteria.

in addition to those effects caused by water use, will be the seasonal change in the quantity of water discharged to the Gunnison River. After the Project is built, water that previously had flowed into the Gunnison River during the winter months and to a certain extent during the spring runoff period will be stored for irrigation. With the storage facilities, water will be available for release for irrigation and other uses during the full irrigation season. Decreased flows during the winter months present a potential for freezing and may result in damage to the fishery and habitat.

Gunnison River water is used to irrigate approximately 250 acres of orchard crops, 250 acres of corn, and 500 acres of alfalfa in the Redland Mesa area of Grand Junction. As a result of the Grand Mesa Project, the average total dissolved solids concentration of the Gunnison River during the irrigation season will be improved by lowering the concentration from 714 mg/l to 695 mg/l. This seasonal improvement in water quality will result in an average annual benefit to the Project of approximately $200.

The most significant impacts from the Project will be due to the increased salinity concentrations in the lower Colorado River where salinity concentrations have already reached critical levels. Present uses of lower Colorado River water include irrigated agriculture in Arizona and Southern California and municipal and industrial uses in Arizona, California and Nevada. The lower Colorado River is a major source of supply for municipal and industrial users in the Metropolitan Los Angeles area and upon completion of the Central Arizona Project the river will provide a water supply for metropolitan Phoenix. Studies (5) by the Colorado River Basin Water Quality Control Project of the Environmental Protection Agency indicate that a 3.0 mg/l annual salinity increase at Lake Mead will result in an average annual equivalent penalty cost1/ to water users of about $205,000 based on 1970 economic conditions. The equivalent penalty cost include a direct cost of $142,000 and an indirect cost of $63,000. Detriments to water users in Mexico and to recreation and fishery users in the Salton Sea are not included in the estimates. Direct penalty costs are yield reductions for irrigated agriculture, treatment costs for industrial users, and the acceptance of undesirable effects or water softening expenditures for municipal users. Indirect costs are spinoff effects on the secondary or supporting industries.

The impact of present and projected uses of Basin water on the mineral quality of the Colorado River becomes greater proceeding downstream from Lake Mead. A progressive increase in salinity concentrations occurs in the downstream direction resulting principally from the salt concentrating effects of consumptive users.

1/ A penalty cost is defined as the difference between the detriments associated with the use of two different levels of water quality; thus, it is based on similar economic conditions which permit the cost effects of water quality to be isolated. Detriments are user cost incurred when a specific quality of water is used.

The quality of the Colorado River water delivered to Mexico is a matter of considerable national and regional concern. Water supply negotiations with Mexico are presently being conducted by the International Water and Boundary Commission.

III. WATER QUALITY CONTROL MEASURES

The Colorado River Basin states have established water quality standards, which have been adopted by the Administrator of the Environmental Protection Agency. However, due to the complexity of the salinity problem in the Colorado River Basin, the establishment of numerical mineral quality criteria for the Basin's interstate waters has been delayed until sufficient information is available to assure that such standards will be equitable, workable, and enforceable. (6) Nevertheless, according to the former Assistant Secretary of the Interior for Water Pollution Control, (7) "It is the intention of the Secretary that the Department of the Interior and the States pursue active programs to lay the foundation for setting numerical criteria at some future time. These programs should focus on devising and demonstrating salinity control measures and finding ways to revise the legal and institutional constraints that could impede the implementation and enforcement of salinity standards."

In the interim before mineral quality standards are established and while salinity control measures are being investigated, certain general guidelines (8) have been formulated for use in evaluating water resource projects such as Grand Mesa. These guidelines are summarized in the following statements:

1. Each proposed project must be examined for adverse effects on water quality.

2. State and Federal agencies must be made aware of the consequences of project development to water quality deterioration and of opportunities that may exist for better quality control on each project. All practicable means must be employed to prevent deterioration of existing mineral quality conditions.

3. Each project feature must be analyzed and justified in accordance with the principles outlined in Senate Document 97.

The information presented in this report has been developed to permit the proper evaluation of the Grand Mesa Project in accordance with the above guidelines.

STORAGE FOR STREAMFLOW REGULATION

Present and projected municipal, industrial and rural domestic waste loads within and below the Project area can be controlled with adequate treatment at the source. Thus, no storage in Electric Mountain and Cactus Park Reservoirs is needed to provide flow regulation to maintain minimum streamflows for the purpose of assimilating residual organic wastes.

Mineral water quality will be degraded on an annual basis as a consequence of municipal, industrial and irrigation uses served by water from this Project. However, during the irrigation season, the average dissolved solids concentrations of the Gunnison River will be improved. This seasonal improvement has no significant economic impact between the Project area and Lake Mead. Therefore, no flow regulation for mineral quality control to protect uses above Lake Mead is necessary.

Below Lake Mead, mineral quality deterioration by the Project will cause downstream water users to suffer an annual economic loss estimated at $205,000 which clearly indicates the need to incorporate all possible water quality controls in the Project. The large volumes of water stored in both Lake Powell and Lake Mead result in the releases from Lake Mead being fairly uniform in mineral quality regardless of any seasonal or annual fluctuations in flow and quality of the Colorado River and its tributaries above the reservoirs. Therefore, any regulation of flow achieved by storage of presently available water in the Project reservoirs will not change the quality of water discharged from Hoover Dam.

In lieu of providing storage in Electric Mountain and Cactus Park Reservoirs for mineral quality control of Project-induced salinity increases below Hoover Dam, other salinity control measures within the Project area should be investigated. Any such measures found feasible should be included in the Project plan.

POLLUTION SOURCE CONTROL

Potential salinity control measures may be divided into two categories : water-phase and salt-phase. The former comprises possibilities for improving water quality by augmenting the water supply, while the latter included prospects for improving water quality by reducing the salt input.

Several water-phase control measures described below appear to have some merit and should be considered for incorporation into the Project.

(1) Phreatophyte eradication on Project lands and along canals and drains could conserve water. It should be recognized, however, that phreatophyte eradication may result in loss of wildlife habitat and winter protection for cattle and sheep. Further study of this control measure would require consultation with the Federal and State Fish and Game Agencies.

(2) Better control of the quantity of water applied through conservation irrigation, the use of irrigation and cropping

methods that best fit a particular soil, slope, crop, and water supply, is another measure which appears to offer possibilities for mineral quality improvement.

(3) Installing closed conveyance systems or lining ditches and canals can result in higher delivery efficiencies and, consequently, improved water quality. Proper land preparation by grading and leveling also conserves water.

Potential salt-phase control measures include the careful selection of land to be irrigated and the provision of better land drainage. Those lands naturally high in alkaline or sodic salts should be eliminated from consideration in favor of soils having low natural salt content. The initial leaching of irrigated lands can be assisted by installation of subsurface drainage systems adequately designed for salinity control. With installation of such a drainage system, the salt load over a number of years may be reduced by preventing percolation to deeper soils with higher salt content.

In order to minimize water quality problems associated with Project construction activities, the Project contract documents should contain clauses making it the responsibility of the contractor to comply with all applicable federal, state, county, and local laws concerning pollution of rivers and streams. This will require the contractor to give careful attention to pollution problems such as disposal of sanitary wastes and production of sediment during construction.

It is anticipated that Electric Mountain and Cactus Park Reservoirs will provide diversified recreational opportunities, such as picnicking, camping, fishing, swimming, and boating. Recreational uses expected at the reservoir are potential sources of pollution that, if not properly controlled, could create local water quality problems both in the reservoir and in downstream reaches of West Muddy and Currant Creeks. Sanitary waste disposal systems with no surface effluent discharges will be required at all recreational areas, including the Grand Mesa recreation area. In the recreation management of Electric Mountain and Cactus Park Reservoirs, boats with waste-holding tanks or containers should be prohibited; or the tanks and containers sealed, unless facilities to receive and treat the contents are provided at appropriate locations. Provisions should also be made to require that fuel-dispensing equipment on docks be provided with safety features that will prevent the accidental discharge of petroleum products to the reservoir. The essential features of waste disposal facilities for recreational areas should be submitted to the Environmental Protection Agency for review in the early stages of planning.

IV. CONCLUSIONS

1. No storage in Electric Mountain and Cactus Park Reservoirs is needed to provide flow regulation for maintaining satisfactory water quality.

2. Municipal, industrial and irrigation uses supplied by the Project-developed water will increase the salinity (total dissolved solids) concentration in the Colorado River at Lake Mead by 3.0 mg/l. This increase in salinity will result in an estimated average annual equivalent penalty cost of $205,000 to users of lower Colorado River water.

3. Regulation of flow achieved by storage of presently available water in Electric Mountain and Cactus Park Reservoirs will not change the mineral quality of water discharged from Hoover Dam.

4. Project construction activities and wastes generated by recreational activities may cause water quality degradation in the Electric Mountain and Cactus Park Reservoirs and West Muddy and Currant Creeks unless adequate water pollution control measures are provided.

V. RECOMMENDATIONS

To mitigate the potential losses to water users resulting from the proposed project, it is recommended that:

1. The proposed project be operated in coordination with all other Federally-funded water resource projects in the Colorado River Basin to meet State/Federal water quality standards.

2. Salinity control features be included as a part of the proposed project to mitigate the expected adverse effects of the project on water quality and water uses. Such mitigation features should be included in the project authorization legislation and provide for installation and operation of salinity control measures in the project area or any other area in the Colorado River Basin where they are found to be effective and efficient. Potential measures include sealing of saline wells and springs, interception and transport of highly saline waters to impervious evaporation ponds, vegetation management, improvements in water conveyance and irrigation techniques, and demineralization.

3. Provisions be included in construction specifications to assure that appropriate steps are taken by the contractor during construction to protect the quality of West Muddy Currant Creeks; and other streams affected by the Project.

4. The future wastes associated with recreational activities on the Grand Mesa and at the proposed Electric Mountain and Cactus Park Reservoirs be adequately treated in systems that will not discharge effluent to the lakes and reservoirs.

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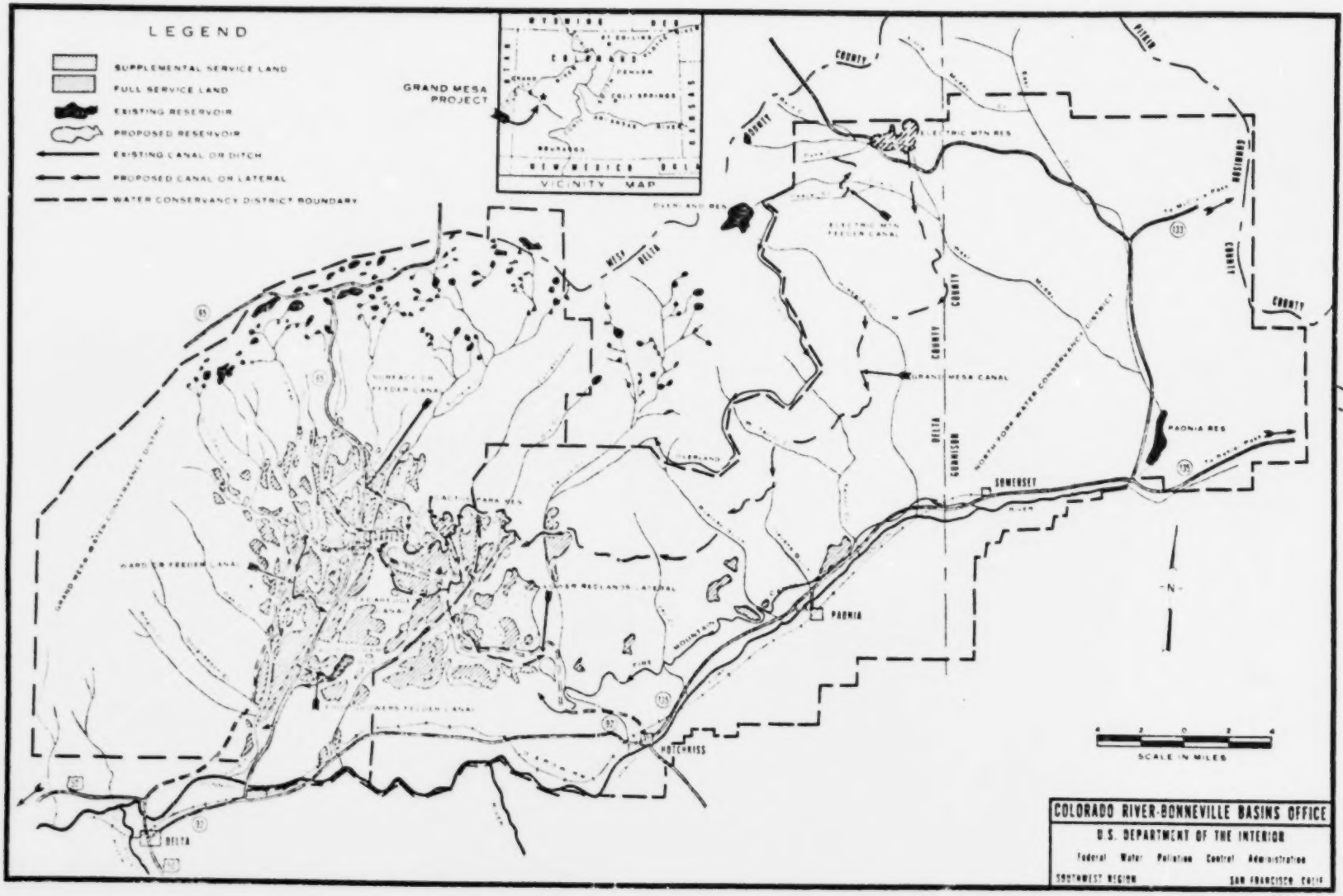

Figure 1. Location Map – Grand Mesa Project, Colorado